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ABSTRACT

A study examined the roles of literacy and teamwork in an automotive parts manufacturing company that was restructuring to implement a "high-performance" model of team organization, worker responsibility for quality control, and a pay-for-knowledge compensation system. The study focused on the formal and informal educational practices from which 480 workers organized into 19 production teams (ranging in size from 3 to 88 members) learned and taught literacy skills. The teams were observed from four vantage points: on production lines manufacturing parts from raw materials, on assembly lines building products from component parts, over the shoulders of workers operating machines, and from a distance to view the team as a whole. Those workers who had lower literacy levels or fewer educational credentials than most of the plant's employees were found to face more educational demands and more limited opportunities for learning than their more highly skilled and educated counterparts did. Although the high-performance model stimulated innovative teaching approaches, including some strategies developed specifically for or by skills-poor workers, most of the approaches proved inadequate to enable the less literate and educated workers to overcome their poor position and improve their literacy skills. (Contains 12 figures/exhibits.) (MN)

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NATIONAL CENTER ON ADULT LITERACY

TEAMWORK AND LITERACY: LEARNING FROM A SKILLS-POOR POSITION

Sylvia Hart-Landsberg
Stephen Reder
Northwest Regional Educational Laboratory

TECHNICAL REPORT TR93-6
NOVEMBER 1993

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TEAMWORK AND LITERACY:

LEARNING FROM A SKILLS-POOR POSITION

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Abstract

This report analyzes the roles of literacy and teamwork in an automotive parts manufacturing company that was restructuring to implement a "high-performance" model of team organization, worker responsibility for quality control, and a pay-for-knowledge compensation system. Within the teams, manufacturing and assembly workers engaged in both formal and informal educational practices from which they learned and taught literacy skills. The focus of the study was the literacy learning environment of workers with lower literacy levels or fewer educational credentials than most of the plant's employees. These "skills-poor" workers, a term used by the company and retained in this report, brought a distinctive set of needs and motivations to the workplace. Moreover, the workplace presented them with limits and opportunities that were different, often in subtle and unplanned ways, from those available to workers with more skills or schooling. Relative to other workers, the skills-poor workers faced more educational demands and more limited opportunities for learning. While the high performance model stimulated innovative teaching approaches, some of which were developed specifically for or by the skills-poor, these approaches often were inadequate to enable the less literate and credentialed workers to overcome their poor position in order to improve their literacy skills.

INTRODUCTION

Hardy Industries[1] is an international manufacturer of specialty products for the automobile industry that has identified certain workers as needing to upgrade their basic literacy skills. By exploring certain dimensions of workplace literacy instruction for such workers, this study focuses first on the plant's innovative compensation system and emphasis on teamwork. Next, it examines the role of literacy in teamwork and the ways workers learn literacy in such an environment. Finally, the experiences of the categorized group called *skills-poor* are examined.

To boost competitiveness and improve quality, productivity, and flexibility, several years ago the Hardy management adopted a high-performance model along the lines of Toyota. They organized the approximately 480 workers into 19 production teams. Named according to the products they made, teams ranged in size from 3 to 88 members. Each team had a leader and a quality technician responsible for quality control who were located near the production and assembly lines. This organization departs from U.S. industrial tradition in that each team collaborates to build an entire product from raw material to packaging and is involved in decisions about the process.

Along with the new social organization, Hardy adopted modern business approaches to increase worker participation: Total quality control was designed to give every worker responsibility for producing high quality products, continuous improvement was implemented to involve workers in planning work processes, and the just-in-time inventory system was designed to reduce waste. To structure means and incentives for workers to acquire the business knowledge and technical and communication skills these workplace changes require, the company developed an in-house system for assessing manufacturing employees' skills, called pay-for-knowledge (PFK). A distinctive context for literacy learning, PFK requires workers to be assessed in a wide variety of work-related and communication skills.

The Hardy production area was a factory environment. The researchers were provided with plastic goggles for protection against particles from machines that grind parts from metal bars. Factory noise-level was high from forklifts and large machinery, making it difficult to ask questions and get responses. Shavings covered the floor to absorb greasy lubricants and liquid coolants

and to take away the sharp edge of fine metal refuse. People watched, interacted with, and consulted with others over their machines. In explaining their jobs to a visitor, however, workers spontaneously referred to the plant's team organization as often as to their machines.

In-depth knowledge of the company and the changes it was undergoing were obtained through participant observation in company classes, including a 10-week course on team problem solving, and lengthy interviews with workers in company-sponsored literacy classes. Personnel in the Hardy human resource department provided tours; data on employees' dates of hire, skills, and other variables; explanations of the purposes and history of the company's restructuring; and assistance in administering surveys on workers' educational backgrounds and attitudes toward change.

This report focuses on five production teams—(a) W808 Assembly, (b) 611-C, (c) Rescue Winch, (d) Miscellaneous Hub, and (e) DuraHub—and highlights 10 of their members whom the company designated as *skills-poor*.

The teams were observed from a range of vantage points: (a) on production lines that made parts from raw material, (b) on assembly lines that built products from component parts, (c) over the shoulders of workers operating machines, and (d) from a distance to view the team as a whole. Workers who packed products for shipping and performed support work such as driving forklifts were also observed. Observations included workers near the lines—conferring, doing paperwork, handling materials, arranging materials for producing a new batch of an item job, fixing and designing equipment, and cleaning up. Also observed were team meetings scheduled by each team approximately every week to discuss issues and plans and work process meetings to analyze and/or improve the work environment or general production procedures.

The skills-poor workers were observed and interviewed. In addition, their team leaders, teammates, trainers, and coworkers from other teams were observed and interviewed about their own work and their interactions with the skills-poor workers. Attention was not restricted to the skills-poor. The team environment was studied, and the activities, concerns, and skills development of workers at many levels of the company were investigated to learn more about the wider context in which the skills-poor work.

Interviews were both formal and informal, as the site afforded rich opportunities to learn about workplace literacy education. A flexible approach facilitated following leads, testing ideas, and returning to individuals whose viewpoints were most instructive. One worker participated in two 90-minute prescheduled interviews after work and many brief conversations at his work station during and after hours. Another invited a close teammate and her husband to participate in the interview she had scheduled to carry out alone. Others chatted informally with the researcher at their work stations, and a few summoned the researcher to explain documents or teaching and learning events. These encounters at the production and assembly lines occurred in the odd privacy that machine noise provided by rendering speech of normal volume inaudible to nearby workers. The researcher also joined workers for breaks and lunches, sometimes asking questions and at other times listening to whatever topics came up.

The content of interviews reflected the unfolding questions of the research. Sometimes an interview guide was devised to obtain specific information such as education and work background, goals, current household makeup, job assignment, the demands of teamwork, activities in the PFK compensation system, and participation in meetings. While sharing their views, workers introduced many related concerns such as their children's education, purchasing a house, diet, sports, nursing a sick spouse, and more.

Handwritten notes were taken during most observations. When tape recording was judged not to be intrusive, meetings and interviews were also audiotaped. Document collection included company texts for regulating routines, such as the PFK notebook; company documents for one-time events, such as the minutes of a meeting, and workers' written materials.

This report examines Hardy's PFK compensation system, the company-wide emphasis on teamwork, the role of literacy in the workplace, the ways in which workers learned literacy in the Hardy environment, and the experiences of the skills-poor workers.

A. PAY-FOR-KNOWLEDGE (PFK)

Team organization sets the stage for all work in the plant and, therefore, is both the context and a major part of the content of learning. In order to understand the role of teamwork, it is necessary to examine the compensation system to which teamwork is linked.

A distinctive context for literacy learning at Hardy, the PFK system required workers to be assessed in a variety of work-related and communication skills. The PFK system was based on five *skill blocks* of 10 to 25 skills each, arranged in order from basic to advanced skills. They were delineated in a large notebook that explained the blocks and the philosophy and certification procedures of the PFK system; the company gave each employee a copy.

Literacy was a major aspect of many of the delineated skills. For example, the first skill block included the ability to read parts lists and assemble parts to specification; apply the concepts of blueprint reading to interpret terminology, lines, views, and details; use basic math to assist the team in problem solving or planning work activities; and make requests from, listen to, and deliver information to internal customers and document the interaction. The company added 15 cents an hour to an employee's pay for each skill mastered up to a maximum of 14 skills in the first block. The highest skills block included diagnosing and solving problems with the most complex machines, advanced programming of computer-numerically-controlled (CNC) machines, tool design, and advanced product testing. Mastery of these skills, many of which require college-level coursework, was paid at the rate of 75 cents an hour for up to four skills.

Workers developed with their team leaders individual written plans for increasing their skills and knowledge through education and work experience. They implemented their plans by taking courses and tests, seeking new work tasks to learn PFK-related skills, and requesting assessments. Many workers became involved in assessing their peers as well. Hardy provided some courses in the plant; others were available at nearby community colleges. The company paid tuition for all personnel. Some classes were required, others were optional; some were offered during working hours, others had to be taken at other times.

The educational background of Hardy's production workers ranged from little or no schooling to college degrees. Although the policy at the time of the study was to hire only those with a high school diploma or equivalence certificate, approximately 20% of the production workers (hired before this policy came into effect) had neither. Workers who graduated from high school tended to have had little experience applying their literacy skills to specialized technical tasks and collaboration at work. Management and training personnel did not see high school graduates as "paper and pencil types" but as "shop types who barely graduated from high school." Many had worked for the company since graduating from high school.

The PFK system was mandatory; all workers had to have their skills assessed to determine their pay levels and to identify new skills to be learned. Many embraced the system in order to diversify their work activities and increase their wages and opportunities for advancement. Certain workers ***had*** to gain skills outlined by the PFK system within a three year period to retain their current wage levels. They were primarily older workers who, by virtue of their long employment at Hardy, earned a wage higher than the PFK assessment system indicated they should for the skills they had acquired. The pay of those who did not acquire the requisite skills in the three year grace period was to be reduced. Employees at various levels of the organization, including the older workers most affected, called this situation a "transitional problem," which they believed would disappear when the older workers retired. Several of the older workers wondered whether, as Daniels (1983, p. 144) expresses it, "the test may win, and [they] will eventually lose [their] jobs."

The passages below illustrate workers' PFK activities and feelings about them. The examples also demonstrate the importance of literacy in many of these activities. Literacy as an aspect of PFK will be discussed in a later section.

"Does Dave get paid for being meeting facilitator?" Jeff asked Todd, his team leader, at the conclusion of a Rescue Winch team meeting. Todd's answer was "yes." "Then I want to do it too!" Jeff responded. Employees were apt to be eager to find or create opportunities for developing new skills that would contribute to a higher wage. After designating Jeff as facilitator for the next meeting, Todd explained part of the facilitator's role on how to write an agenda. "Not to knock the way Teresa did it," he said referring to a previous meeting, "but you're supposed to put the

topics down without the names, the way Dave did. But you both did a good job," he assured Teresa and Dave.

"I don't want to drive a Hyster for $.10 an hour!" Paid-for skills were not always eagerly sought. Linda, of the Miscellaneous Hub team, resented the pressure to learn many new skills. A 36-year-old assembler who joined Hardy six years earlier as a recently divorced mother with no high school diploma, she valued her job highly but was ambivalent about its educational requirements. She described the importance of her daughter's recent graduation from high school and wanted to continue her own education but on her own schedule. She resisted the *pressure* to learn forklift driving because in a company where she previously worked, a woman was crushed to death by one. She thought the company was doing too much cross-training for its own good. She said, "Everyone's riding around in a forklift!"[2]

"I never imagined that I could operate this machine." Sometimes workers appreciated new skills that they had acquired because the PFK system made them mandatory. Emily, a 40-year-old assembler on the Rescue Winch team, was pleased after completing her first week operating the Kaltinger, a machine to grind parts—one of the most complex machines in the plant. Emily had stayed home with her two sons when they were children and felt it was one reason they had had so few problems. When they moved away from home she entered the labor market, but she continued doing considerable homemaking and was engrossed in settling into a newly purchased house. Her primary aim at Hardy was to do routine work, not to assume extensive responsibility or to take on educational challenges after hours. In the new environment, however, she was expected to extend her aims in both of these directions. When the team leader scheduled each member for cross-training in new roles, Emily's role was to operate a machine that experienced workers said took "at least five years to know." She was, however, proud and surprised that she could add such an accomplishment to her list of PFK skills.

"You need the courses if you really want to understand [the machine]," said Chuck of the Rescue Winch team, a gray-haired machine specialist who had been operating a Kaltinger skillfully for many years. Some workers believed that even though they already operated the machinery adequately, relevant coursework would make them experts. Chuck took a night course on programming the Kaltinger's high-tech successor, a CNC machine he operated. Due to a severe health setback, he had to enroll in the class a second time. He felt that he could pass the test without the

class but preferred to be assured of his proficiency by passing the class itself. He wanted to take algebra and trigonometry next because he liked math and believed the knowledge would improve his performance in operating the CNC.

"I'd like to see some in-house classes after working hours," reported Catherine, a W808 Assembly team member whose shift ended at 3:30 p.m. At times workers pressed hard for more educational opportunities. Catherine took many evening courses at the community college at the company's expense before PFK was "in the air." In a team meeting she had several complaints and suggestions related to course availability:

> *I hear through the grapevine that Josh [responsible for the PFK system] is going to start some classes at 3:00. Why can't I come in half an hour earlier [to quit earlier and take the course]?....A lot of us that are old-timers have a deficit in PFK. We need an opportunity or we're going to be sitting where we are....I took a class and I aced it. When I brought my transcript here I had to take a test. Why?*

B. TEAMWORK

Darrah (1992) has pointed out that production work is primarily a social process, but the social skills it entails are often difficult to observe. The wire and cable factory workers he studied saw machinery and production, not communication, as the kernel of their jobs. In contrast, Hardy manufacturing and assembly employees, responding to the explicit emphasis on teamwork and the classes they were required to take, talked about teamwork more than any other skill. Teamwork was significant to them also because it structured their activities. This section describes teamwork activities and related issues through the eyes of employees and discusses the relationship between individuals and their teams. Literacy practices occurred as a major component of many of these activities and issues; they will be addressed separately in the following section.

1. TEAMWORK AS SEEN BY EMPLOYEES

A. EMPHASIS ON INTERPERSONAL SKILLS

Hardy workers often maintained that the most taxing aspect of teamwork involved communication skills, as well as being sensitive and cooperative in relating to others. Teresa, a 26-year-old machine operator on the Rescue Winch team, described the collaborative skills demands of her job:

> *Phrasing things right, getting in a circle to solve problems, finding a way to agree, understanding the function of a job...how a part and the process [for making it] fit into the whole picture, getting a second opinion on what's wrong with a part, learning that it can't be my way—it's got to be our way—communication, blueprint reading, writing, reading the micrometer, doing basic math, proportions for checking on a process sheet, detecting failure on the [assembly] line.*

Teresa's first concerns were the interpersonal aspects of collaboration—"phrasing things right...finding a way to agree." Only after examining the social organization and her role as part of a larger process for making a product—"getting in a circle...learning that it can't be my way"—did she turn to the more technical skills, which she recited from the PFK blocks (e.g.,

blueprint reading). Her response was typical in its emphasis on the challenge of human relations in a teamwork environment.

B. COOPERATION ON THE PRODUCTION LINE

From the worker's point of view, teamwork on the line meant that there was always someone waiting for your work and you were always waiting for someone else's. A machinist, Nate, described teamwork this way:

> *Teamwork takes a lot of smarts! I never really fell into it too much. If one person's goofing off...we get into a group about it...go at it at a positive level. In [a previous team] everyone had their own benches. [There were] different kinds of kits....Each kind had a row. You went shopping for your parts and checked off on a pick list when you had them. If someone is off or sick you do their job and yours and keep the flow going"*

Nate's description, which concurred with other workers' analyses, identified three aspects of teamwork on the production line: (a) difficulty of teamwork, (b) group problem solving, and (c) organization of teamwork. First, teamwork was difficult; it took "a lot of smarts." Second, it involved group problem solving; "we get into a group...go at it at a positive level." In one instance, Melissa, the W808 Assembly team spokesperson who made decisions on the line when the team leader was absent, spontaneously stopped the line and halted production for a few minutes to discuss the cause of a recurring defect in a hub. Occasionally a formal team meeting was scheduled to solve a recurring problem. Third, teamwork was organized on the assembly line to cover for an absent coworker by increasing the workload of other team members.

C. COOPERATION IN MEETINGS

Meetings to analyze and improve work processes highlighted particularly intricate forms of collaboration. Failure mode effects analysis (FMEA) was one form of work process meeting. Individuals with various responsibilities for a product—design, production, assembly, quality control—followed an intricate FMEA procedure for identifying and writing up potential production problems, the probability that they would occur, the kinds and severity of their effects, and ways to prevent them. (See Appendix, Form 1, for sample of form that helped structure FMEA meetings.)

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Archie, the W808 Assembly team quality technician, described an FMEA meeting:

> *The main purpose is to get the point of view. Engineers always have done this but they have not included the manufacturers' and assemblers' knowledge. I could have done this whole FMEA myself and might have come out with the same thing, but there's always the chance you'd miss something. Irwin, [a manufacturing employee] in the last meeting, raised details about the size of the hub rim I would have missed. I learned a lot in the meeting. The others probably did too....The key to good teamwork is understanding. Respect. It's amazing what people can do if they are treated with respect.*

So important and subtle were the skills for interacting in a meeting of this type that Archie found it necessary to introduce his philosophy of teamwork. *Understanding* and *respect*—his terms—enabled him to hear points of view, with the aim to improve worker performance on the factory floor.

D. THE CHALLENGES OF TEAMWORK

Employees spoke spontaneously about the challenge of applying concepts from teamwork classes to the exigencies of work life. Will, an energetic Miscellaneous Hub team member to whom others looked for guidance, noted, "Some of the new skills do contribute to productivity, some don't. People have to *apply* the skills; it all comes from personal motivation."

In a similar vein, Margaret of the 611-C team referred several times to her attempts to solve problems the "working class way," that is, by following the problem-solving format of a required course of that name. Workers also talked about striving to extend their new skills into their domestic lives. One man claimed that his use of problem-solving techniques with his daughter kept her from "going to jail."

2. THE RELATIONSHIP BETWEEN THE TEAM AND ITS MEMBERS

A. INDIVIDUALS NURTURE THE TEAM

During a lunch break, several 611-C team members sat around their work area to eat. Melissa, the team spokesperson—who "took care of things" when the team leader was away, led daily five-minute stretching exercise sessions, and has been referred to as the

team's *mother*—made several comments about her bad mood ("I'm really bratty today") and ribbed two teammates about their own bad moods. Back on the line after lunch she continued to make loud, cheerful remarks. Suggesting to the researcher that this was a conscious strategy for inducing smooth teamwork, she commented, "How's our communication today?"

B. TEAMS NURTURE INDIVIDUAL MEMBERS

The Rexford, a machine for grinding metal bars into components for automobile accessories, crashed. Teresa was finishing her first week as its operator. Team members milled around, trying to figure out the cause of and the solution to the crash. Teresa said to anyone who was listening, "It had to have something to do with the operator." Jeff disagreed, "The same thing has happened to all of us." Then he warned her that the tooling experts assigned to troubleshoot this problem probably would tease her as they do all operators involved in such breakdowns. Immediately an expert arrived and took Teresa aside to talk to her.

Later, another young machinist on the team, Carrie, told the researcher, "The problem earlier on Teresa's machine was *not* her fault. It was the machine's. Some of the best machinists come out from a situation where the machine crashes all the time."

A week later, "Update on the Rexford" appeared on the team meeting agenda. Chuck, an older worker with years of experience, recounted how he "rebuilt...remade...realigned...and re-centered" all the machine parts that had been "wiped out really bad...burnt up...shoved back...had gullies in them" and so forth. After participants stopped chuckling at the extent of his chores, Chuck asserted, "It's not Teresa's fault."

Teresa still seemed worried about her culpability. She said, "It was only the second time I've loaded bars...but Emily loaded a similar bar [with no breakdown]."

Participants then launched into a technical analysis of bar size and developed a new recording procedure for tracking undersized bars.

The team's response to the breakdown was to support Teresa and attempt to improve the production process by creating a new type of written record. They were not unusual at Hardy in choosing not to pinpoint individual errors.[3]

C. Literacy in Work Activities

This section discusses the ways in which literacy comes into play in three categories of activity at Hardy: production, meetings, and PFK.

Production activities occurred on a production or assembly line and involved making, assembling, or packaging parts or preparing materials and tools for that work. The direct results were the products the company sold.

Meetings focused on the work process and environment, and workers left their production lines to attend them. There were two basic types: ***team meetings*** to discuss and plan team activities (weekly in most teams) and ***work process meetings*** to analyze and improve specific work processes or standards (e.g., writing FMEAs, process control instructions, quality improvement processes, and work site standards).

PFK activities involved workers in taking classes and tests, having their skills assessed, and assessing others. The duty of each worker to participate in the PFK assessment system was conceptually separated from the duty to produce goods or attend meetings about the production process. Although some skills were assessed at work stations (as when an experienced worker signs off on a specific skill performed by another), PFK activities were supplemental to and defined as different from the task of producing hubs and so forth.

In Figure 1 the three categories of activity are represented by the horizontal bars; the frequency of literacy practices involved in each category of activity is represented by the pie-shaped section. The pie shape is narrow at production because literacy practices were relatively infrequent, although not unimportant, during production. It widens at meetings because the frequency of literacy practices increased as activities became distant from production. It is widest at PFK because of the relatively great role of literacy in the assessment system. (See Appendix, Figure 1.)

1. Literacy During Production

In general, literacy requirements on production and assembly lines at Hardy were limited to tagging defective parts, reading and making labels, and other small but essential tasks. However,

production workers performed other routine literacy practices—such as reading work orders, calculating and reporting the number of products produced—near the production line, sometimes with assistance from others. These ongoing communication tasks required multiple literacy and teamwork skills, collecting data from team members, reading fine print with technical vocabulary, calculating averages, and so forth. The usual time allotted to them was the 5-minute cleanup period at the end of a shift or before and after a batch of products was produced.

As workers' responsibility for quality and efficiency increased in the company, the narrow slice of literacy practices directly related to production also widened. Sometimes workers independently assumed such literacy tasks. Anne, a Team 611-C assembly worker, sketched a dryer for plastic parts (Appendix, Notebook Exhibition 1.) that she wanted Norm, the team tool design engineer, to build or purchase. Her request was not out of order, for Norm frequently consulted with assemblers, demonstrating uses of equipment and listening to their suggestions for improvements.

2. Literacy in Meetings

Team meetings were often used to interpret and create documents. Although the meetings had printed agendas and involved written surveys and other documents, meetings usually involved more oral problem solving and interpersonal relations than reading and writing.

In contrast, the main purpose of work process meetings was usually to collaborate on the writing and interpretation of technical documents. The meeting described at length below was typical of work process meetings. It features Judy, a 41-year-old assembler.

Two years ago Judy left her role as a full-time homemaker to earn money for her son's college education. The family decided that while he was in high school his success would be promoted by leaving him free from after-school work to study and participate in extracurricular activities. They arranged for him to take care of his younger sister after school, freeing Judy to earn money for his future tuition. Judy, who completed high school and was not considered skills-poor, was a zealous learner in the PFK system and took evening courses in math and statistical process control (SPC). She applied for the unusually responsible assembly position she held and remained mindful of her potential for promotion.

Judy's production task was to build four types of hubs, which she usually did alone, thus forming her own "cell" within the 611-C team. She came to the meeting to help write process control instructions—detailed production procedures required by the manufacturer who bought Hardy products—for the 470A hub. The other participants, Ethan and Steve, were engineers.

Before the meeting, Judy collected documents to bring with her. She jotted down the names and numbers of the machines she used to assemble the 470A hub (Appendix, Notebook Exhibition 2) and searched the cabinet in her assembly area for other relevant material (a task in itself, for the cabinet contained the paperwork of another cell as well). She extracted the minutes of the last meeting on her cell (Appendix, Notebook Exhibition 3), a list of the six major tasks in addition to writing process control instructions required of each type of hub she assembled (Appendix, Notebook Exhibition 4), old process control instructions (Appendix, Notebook Exhibition 5), a materials list for the 470A hub (Appendix, Notebook Exhibition 6), and the process control instructions for the 480 hub to use as model.

At the meeting, Judy collaborated with Ethan and Steve to create the new process control instructions. Steve opened the meeting by reviewing their list of tasks and getting Judy's opinion on a number of questions: the best sequence of tasks, whether the due date was realistic, which secretary would type the document, when the team leader would have time to take photos, and what sorts of diagrams would be inserted. Then they created the new instructions by editing the recently rewritten instructions for the 480 hub (a strategy observed in other work process meetings). Judy's role was to provide information on the materials and processes she uses to assemble the 470A. At one point, Ethan objected to Judy's assembly procedures:

Ethan: "Wait a minute. You can't do that with this [hub]."

Judy showed him with the actual hub casement and spring on the table that you can.

Ethan (reading the old process instructions): "Put the spring down lady!" (laughs)

Judy: "O.K., but we *had* to do this first."

Ethan read her the sequence as written.

Judy (reasserting the order of actual assembly): "I do them at the same time."

Ethan: "Well it says here....So let's reword this."

Both Ethan and Judy acknowledged her strong role. When he tried to hurry the meeting by saying, "I got to get out of here pretty quick....Are we almost done with the process?" she quipped, "I'm going to lock the door." When Judy figured out which of two parts they needed to write about, he said casually, "Go ahead, make up my mind for me."

Although his role was distinct from Judy's, Ethan was not passive. For instance, it was he who decided that Judy should pencil edit the materials list and the 480 hub process instructions. He was the one who dashed out to photocopy extra copies to mark on.

A similar specialization occurred in other work process meetings. The workers who manufactured the products provided technical knowledge about that work, while the engineers and team leaders brought technical expertise about creating documents, (i.e., formatting, wording, editing, and instructions for the secretary).

At the end of the meeting, Judy gathered her notes, drafts the group had created, and material others had brought to the meeting. These additions to her stack included a list of things to do or get someone else to do, such as remind the team leader to take photos of assembly equipment to insert in the process control instructions (Appendix, Notebook Exhibition 7); a copy of the 480 process control instructions that had been edited to become the 470A process control instructions (Appendix, Notebook Exhibition 8); an old materials list, edited to represent the materials currently used to assemble the 470A (Appendix, Notebook Exhibition 9); and a book she planned to "go through at home" to find machine numbers to insert in process control instructions that had been written previously.[4]

Judy's participation in this meeting illustrated the considerable literacy, teamwork, and organizational skills that a Hardy worker applied in coproducing a document about production line work. Although literacy and teamwork did not produce hubs during the meeting, they reflected on and influenced that production.

3. Literacy in PFK Activities

The PFK assessment system required workers to use literacy skills to determine their position and advance within it. The

following account demonstrated the way a worker used literacy to get skills *signed off.*

Kim had been hired in a permanent position on the 611-C team. She left her work station to get her PFK assessment sheet from her locker and showed it to Claire, her informal mentor in steering through the PFK system. Claire asked whether a certain skill was in block one or two. When Kim did not know, Claire directed her to get a copy of the PFK notebook from the team leader, Bob. Regarding another skill Kim wanted to get signed off, Claire said, "Josh [the company trainer] will do it." Claire quizzed Kim about a third skill, revealing that Kim knew how to build a certain winch but not how to box it. "Can you get this signed off?" Claire probed. "I can ask," Kim responded hopefully. Claire told her to call someone from the winch team. They discussed who to call. Claire pointed out the phone numbers listed under the phone near their assembly line. Kim decided, "No, I'll do it during break."

Kim's work to get skills signed off illustrated individual and collaborative literacy tasks—using the PFK notebook, phone number list, and skills sheet—tied to PFK responsibilities. Employees were required to determine their position in the system and try to advance through it. Claire expressed a major incentive for participating, "When I got hired, I went up to $6 an hour. Now I can get skills to go higher."

4. Discussion

Hardy constructed manufacturing jobs so that each worker's competence depended in part on the ability to compose and interpret written communications, often in collaboration with others. Because of the ways the work was organized, no one could make parts or assemble final products without being able to read instructions and record results. These communications often were complex, such as narratives describing interpersonal difficulties and numerical scrap reports on defective parts that could not be reworked. Workers also were required to employ literacy in meetings that were removed from production. In a neat twist, the obligatory PFK participation demanded active use of literacy skills to determine needed literacy and other skills and to document skills acquisition. As a consequence, overall competence as a worker at Hardy was defined in part by competence in the literacy activities in all three categories of work activity. As Cook-Gumperz (1986) discussed, these literacy skills were not simply technical, but context-bound prescriptions for specific uses of literacy. Their mastery was essential for success in the workplace.

Paradoxically, literacy did not always have a high profile in factory life, however significant it may have been. In terms of performance, the main aim of both the company and its employees was to make parts. Most workers focused on the tasks that they intended to accomplish by means of literacy, rather than concentrate on literacy itself. One reason that most workers did not highlight literacy was that they considered themselves sufficiently literate and focused on attaining different, although often related, skills.

D. Teaching and Learning Literacy in Work Activities

This section focuses on the teaching and learning that occurred as literacy was practiced through team-based education, whether formal, planned, explicit, or conscious. The discussion provides a background against which the experiences of workers with fewer literacy skills and less education can be explored.

1. Teaching and Learning Related to Production

Most Hardy workers occasionally functioned as teachers on the line, and many could cite clear reasons for their ways of teaching their work to others. Kyle, a machinist on the DuraHub team who was an ardent student in the PFK system, articulated his approach to teaching novices:

> *I like to teach people how to run [the machine] for a while before teaching them how to set it up....I feel if you can follow a set-up sheet it will reduce your time. A previous worker on this position feels [being able to use the sheets] doesn't tell you how to run a machine. But a new guy has had a short training time. On the first runs I didn't let him use sheets because I wanted him to know what each part does. But I stayed right near him while he set it up.*

On the factory floor, teachers sometimes became learners and vice versa. The following example shows Anne, the more experienced worker, learning along with a novice, Charlotte. In explaining the event, Anne did not claim to be a teacher, but said that she "had done it before" and Charlotte "was learning it for the first time."

At the end of a shift, Charlotte asked Anne to help her record the team's production. Anne had been assigned to this rotating paperwork task four months prior, but its procedures had been changed slightly. Consequently, Anne and Charlotte figured it out together. In completing the log entry, Anne asked questions of Charlotte, who examined the entries for the previous month to infer the general rules for filling it in. The two called another team member, Frances, to help them fill out the Travel for Work Order

form. Charlotte sought her close attention: "I'm confused, so would you please watch me do this?" Frances showed them how to find the data on their time cards and fill in the form. Next, she directed them, "Every time you complete these they go straight over to Catherine because she's completing them." Anne and Charlotte put their papers in the required sequence and posted one on the team bulletin board. Finally, they concentrated on filling in Charlotte's time card.

The interaction illustrated a relatively informal approach to a relatively formal instructional intent—to transmit a certain skill. Workers, in general, were adept at developing instructional materials from documents on hand and finding teachers from available personnel.

2. Teaching and Learning in Meetings

Meetings provided opportunities for workers to practice sophisticated literacy skills in tandem with technical knowledge about the chemistry, physics, and mechanics of production as well as the economics and politics of company life.

Irwin, a 36-year-old machine specialist on the Linkage Hub team, demonstrated several ways that the educational potential of a meeting situation could be developed. He had worked at Hardy for 11 years and was considered a good worker with well-developed literacy skills. In the course of one 75-minute FMEA meeting, Irwin raised an issue about the proper use of equipment, suggested a hypothetical situation to clarify understanding, contributed information on his production process, suggested fine distinctions in wording, asked about technical details of others' work, indicated that he was listening carefully to information provided by others, explored answers to questions, sought information on customers, voiced agreement with conclusions reached, and opened a discussion of the best approach to doing FMEAs.

With regard to the FMEA process for seeking the source of a problem, Irwin probed, "My FMEA instructor said to focus on the process, not the agent." Archie, the quality technician who was facilitating, responded, "In my opinion, we need to keep the human element in there." In this exchange Irwin called into play his experience at an FMEA meeting five months earlier in which the consensus had been that individuals must not be identified as causes of production problems.

Irwin was a worker who shaped opportunities from classes and meetings to increase his success in the plant. While Irwin's

intensity was unusual, other workers were observed to extend learning opportunities in similar ways.

3. Teaching and Learning in the PFK System

The PFK system was an important vehicle for acquiring and polishing literacy and other skills. Literacy learning was inherent in courses workers took, new tasks they assumed to upgrade their skills, assessments in which they may have been the assessed or assessors, and management of their personal PFK paperwork detailing the skills they needed and how they planned to acquire them.

One example of how the PFK system structured literacy practice was the requirement that each worker be certified in teamwork skills. As teams, they took teamwork classes that encompassed many literacy practices. For the W808 Assembly team, a community college instructor came to the plant to teach a course entitled "Team Problem Solving," which included exercises in applying recommended practices to hypothetical and real problems on the shop floor. An obvious function of the class was to provide time in class for reading, writing, speaking, and listening in a group setting.

Dale, 45, used the teamwork class to fashion literacy lessons to supplement his basic reading and writing course. Labeled brain-damaged after an accident in early childhood, Dale had not attended school, and the Hardy PFK system was his first opportunity for literacy education. His socialization on the streets and in reform school and prison did not include reading instruction. When he started at Hardy 14 years ago, he found it necessary to devise a code for recording the instructions an experienced machine operator gave him for running his machine.

Dale usually remained silent in the team problem-solving class, in part because in an earlier course he felt that team members looked down on his skills and that the teacher "put him on the spot." He did, however, voluntarily present a version of the team's analysis of a housekeeping problem that he had written at home (Appendix, Notebook Exhibition 10). He also reported that he read the class handouts at home, a lengthy process that required the use of a dictionary and word-attack skills his reading tutor was teaching him. Although Dale was exceptional in his enthusiasm for pursuing literacy in conjunction with the teamwork course, all the students encountered literacy as an inherent part of it.

Teaching and learning of literacy, teamwork, and other skills propelled each other during production, meetings, and PFK activities. Workers actively shaped these literacy events into informal lessons for furthering their own and others' literacy skills.

E. TEACHING AND LEARNING AMONG THE SKILLS-POOR

This section focuses on the skills-poor workers who were most challenged by the demand to pursue literacy skills and educational credentials in Hardy's restructuring environment and examines some dimensions of their experience.

Hardy was *not* a comprehensive school that identified and met educational needs unrelated to work, nor did it intend to be. To the teachers, learners were not students but *people in my class*. To managers, they were *employees*. To peers, they were *other workers* or *teammates*. When a newcomer was assigned to learn from an experienced worker, the two were called *buddies*, a term that did not connote transmitting and receiving knowledge. Hardy attempted to provide for all workers, including those who were labeled skills-poor, an environment suitable for learning some work-related skills and incentives for learning others. Its educational mission was to recognize and to help to fill those educational needs that were significant to the company.

Thus, in spite of some successful efforts to the contrary, the Hardy environment was less advantageous for the skills-poor than it was for the workers who faced fewer challenges in learning basic skills. The issues involved in differential reading instruction are complex (Bruner, 1983; Collins, 1986; Hart, 1982), and even institutions whose main purpose is education spend enormous energy attempting to resolve them. At Hardy, the educational treatment of the skills-poor had the following distinctions: (a) they were required to set more burdensome educational goals than other workers, (b) work group assignments associated with enhanced learning opportunities were less apt to come their way, and (c) haphazard special educational methods were employed for teaching them.

1. WHO ARE THE SKILLS-POOR?

The PFK system led to the identification of workers who were skills-poor. With the help of team leaders, workers identified basic reading and writing skills that they needed in order to acquire the PFK skills and included them in their individualized PFK educational plans. Approximately 6% to 8% of the manufacturing and assembly population were identified as needing basic skills in

reading, writing, or numeracy and/or a GED certificate; approximately 4% to 6% were identified as needing basic skills alone. Josh, a Hardy trainer, found these percentages similar to those in other companies where he had been employed.

The kind and level of literacy of the 10 skills-poor workers varied. Two were non-native English speakers whose main challenge was to learn English and concomitant lessons in culture. Some read and comprehended job-related material quickly. Two had hidden their *illiteracy* for years but could no longer do so given the company's increasing emphasis on literacy. One worker had particular difficulty performing literacy tasks when others were observing. One could not perform simple addition and subtraction. From their perspective, a useful way to express their challenges was to focus less on their need for the targeted skills and more on their need for an environment that recognized their existing and developing skills and provided the means for success in learning new ones.

The skills-poor brought a wealth of skills from outside the workplace and actively used them to enrich their learning. For example, Nate believed that he contributed a capacity to cooperate that sprang from his practice of Christianity. Although he expressed panic that he would not be able to succeed in teamwork classes, he felt more confident about teamwork outside of class: "These classes all boil down to being good, being honest, talking to people. I learned all about that in church!"

Most of the skills-poor workers demonstrated resourcefulness in practicing skills on the shop floor and in classes, harnessing the support of superiors and finding teachers. Dale, who was socialized on the streets and in prison, recounted that he first learned about the PFK system when he overheard people reading and debating posted notices of the impending restructuring that he could not read himself. When he went to the company's owner to express anxiety about his low skills, the owner put the responsibility back on Dale's shoulders. "What are you going to do about it?" At home that evening, despondent as he discussed the situation with his wife and children, Dale happened to hear a literacy hot line number on television and decided to dial it. That act initiated his formal education. His account exemplified that workers actively use what they consider to be the *pressures* for education to seek learning opportunities.

The active stance of workers toward their education often took the form of creative curriculum design. Nate, for example, turned

his job setup task into a reading lesson. This task involved reading a list of parts identified by name and number and collecting them for assembly. At first he was able to read only the numbers; after he learned the names of the parts he began to read the words next to the numbers, thus increasing his reading vocabulary.

Workers designed support systems for their own learning. Larry, a 38-year-old assembler, recalled his childhood trials of trying to read; sometimes he was able to decode the sounds represented in writing but rarely the meaning. After dropping out of high school, he enlisted in the army where he received some literacy education but did not resolve his literacy problems. His siblings helped him to apply for his present job when he retired from the army. Managers and workers referred to Larry as *dyslexic*. He cultivated supportive relationships with several people who were willing to help him in spite of the mood swings that affected his cooperation. Heather routinely "explained things" to him without "put-downs." Alice "helped him with his time card," that is, she filled it in while he swept her area for her. Chong Ae, an English-as-a-Second-Language student, provided an example of a simpler support system: during breaks she asked teammates to help her do her English homework. This way she avoided burdening her busy family with requests for help.

The kind of literacy learning an interaction supported depended greatly on the personality of the learner involved. Nate felt threatened by the plant atmosphere charged with educational concerns, specifically by the demands to improve his literacy skills and to participate in classes. Other skills-poor workers expressed a similar fear of classroom settings. One 45-year-old worker who left high school after 10th grade and had not earned a GED certificate was uncertain that he could accomplish his PFK goals. When he came to Hardy two years ago, Nate attempted to hide the fact that he could not read the materials required to do his task. Kusterer (1978) points out the significance of cultivating an image of competence, as Nate and Dale tried to do. Painfully aware that his attitude increased the difficulty of the educational challenge, he contrasted himself with Fred, a skills-poor teammate:

> *He works a lot by numbers too. One day I said, "I'm scared of this class." He said, "The class can't eat you." It made me think he looks at it different....He doesn't care as much what people think.*

Nate's view that fear held him back was echoed by a team leader who compared him with Dale. "Dale's fortitude, repetition, creativity, diligence, [the fact that] he makes no bones about being illiterate help him progress." He saw Nate, on the other hand, as letting his "introversion" hold him back. Nate's own team leader, Max, encouraged Nate to become more extroverted by admitting his problem to others as did Dale.

2. What is Literacy Education Like for the Skills-Poor?

A. Two Sets of Educational Goals

Tracy, who took an informal leadership role in her team and was not skills-poor, saw the demand to upgrade one's skills as a burden. "Classes are irritating because you have homework on your own classes," she said. "You have team classes, you do your job, and you try to have an outside life."

For the skills-poor who had to take basic skills classes and had a hard time in them, the burden was more than irritating. Some comments were:

> *Why are you hiring me to torture me?*
> *I'm about to have a nervous breakdown.*
> *I learn better when I'm calm and relaxed, without a class. I've always got the classes hanging over my head.*
> *[With a family and required overtime work] it's hard to take all these classes.*

These workers felt that they had to participate in a double educational system. To fulfill general educational goals they were required to study basic literacy skills and/or earn a high school diploma or equivalence degree. To fulfill goals in applied skills they had to take classes on teamwork and technical skills. The majority of skills-poor workers who were interviewed felt overwhelmed by their double educational programs.

Some were family-oriented individuals who wanted to work hard on the job and go home without homework, or at least with homework in only one of the educational areas. Emily expressed their outlook:

> *My boys are good kids, and one's in college. They are into rodeos, and our family time is spent driving all over Oregon...I get too tired to do*

homework, and then I think that I can't understand it.

Others were reticent learners who believed that they could not learn basic reading, writing, and numeracy skills fast enough to be able to handle courses in applied skills.

Skills-poor workers tended to wish that they could focus on the first set of goals before being required to take courses in the second. There were two major reasons for this. First, they felt that basic skills and/or a degree would earn them self-respect. Their educational aspirations followed the pattern of a wider society in which schooling accomplishments are endowed with great moral value (Horsman, 1990). They did not believe that these aspirations were achieved simply by learning skills more closely related to factory work. Although they valued the applied skills for the pay and workplace competence associated with them, achieving a high school-level education and basic literacy skills were seen as even worthier achievements. Second, many of the skills-poor felt that if they had the basic skills first, the applied skills would "come easier."

As Nate expressed it; "If I could just read at 8th- or 9th-grade level I could whiz right through this job....I don't think there'd be much pressure if a person had a little knowledge behind him."

Max, Nate's team leader, saw the dual nature of Nate's struggle and made adjustments for it. He explained, "Nate has asked me not to sign him up for too many classes....It all came out....He has the struggle of outside as well as inside classes. To me, the...foundation is more important than anything."

In addition to reducing Nate's course load, Max tried to provide "a better learning environment" on the shop floor. "You don't want to ever make him uncomfortable," he said. "....I'll never put him in a position he's apt to fail at....I don't dare give him written instructions."

Max was typical of trainers and team leaders. Company practice encouraged individuals to develop programs to fit their own style and speed (e.g., study from workbooks rather than in classes, advance at their own pace, and retake classes). Sometimes workers who were self-conscious about their literacy skills among their teammates were allowed to take teamwork classes with groups of skills-poor coworkers instead. The company made some efforts to tailor not only educational goals but also educational environments to learners' needs.

The skills-poor workers were not totally negative. The same workers who protested against the *pressure* to take courses also raved about the company's opportunities for education. Both family-oriented and reticent participants tended to claim that Hardy's educational opportunities were valuable for those more skilled and, more hesitantly added, that it was "good" for them. "I *know* that it will benefit me," Emily asserted, quickly adding, "but I don't want to be benefited at this time of my life!"

B. Fewer Opportunities to Practice Literacy

Work process meetings offered rich opportunities to learn and practice literacy and other skills, but opportunities to participate in these meetings were limited. Managers tended to pull together individuals for these temporary work assignments by selecting the more literate workers.

Bruce described the criteria he and other team leaders used to make such selections. First, they preferred individuals who actually performed the task being analyzed or knew about specific aspects of it. By this criterion, workers of all literacy and educational backgrounds were apt to be included. However, they also tried to include people who had asked to be involved and tended to prefer those who had shown an interest in the assigned topic and type of work in the past. Thus, workers with low literacy skills and little confidence about speaking to individuals and groups at work may have been excluded from some meetings. In addition, other qualifications being equal, the managers were apt to prefer a worker with higher literacy skills. Bruce expressed it this way:

> *I'd pull [off the line] the person doing the work even if he was illiterate—as a technical resource. Someone else might write it up. I'd ask him, 'How, why do you do that?' They may not understand why they are doing it, but they know the process. If you can read, the more you are exposed, the more your skills can improve. But you would take the more highly educated person for a group if you had to choose between one who has literacy skills and one who doesn't.*

Bruce's phrase, "the more you are exposed, the more your skills can improve," distills the fundamental approach to learning and teamwork at Hardy. As many examples have shown, workers learned new skills through exposure and practice in their jobs and company-supported training. But, as Bruce pointed out, this approach to learning was successful only *"if you can read."* He

was in agreement with Nate and other skills-poor workers who longed to focus on basic skills first so that they would have the means to acquire additional skills in work settings.

C. SPECIAL TEACHING AND LEARNING STRATEGIES

Special treatment was a significant phenomenon in the team-based literacy education of skills-poor workers. Managers' willingness to help workers individualize their programs had already been described. Line workers also went out of their way to make allowances for others' skills needs and to provide support for the learning process. Max, Nate's team leader, observed that workers generally were readily motivated to teach those who were much lower on the skills ladder. He articulated the reasons with reference to Nate. "The team helps him," he said, "because he contributes good work. It's *worth* it to them to cooperate with him. Also, if *he* makes a mistake, *all* pay."

Two additional motivations were evident from observations and interviews: (a) helping others created a pleasant working environment for everyone; and (b) a feeling of pride accompanied the ability to teach, especially when the learners were perceived to be difficult.

With these motivations, higher-skilled workers often diligently attended to the learning needs of the skills-poor. As teachers who worked with children know, learning to read and perform other basic skills is closely related to self-esteem, peer relations, and work habits. Similarly, the problems of some adults who cannot read well or do not have "the piece of paper" (a high school diploma) can become compounded. The Hardy workers who became their teachers had elaborate routines for dealing with the difficulties they presented.

Larry's low literacy skills were reflected in the frustration and anger that he expressed on the job. To gain his cooperation and support his learning, his coworkers distracted, bribed, and ignored him; gave him easy tasks, showed him how to do them, or did them for him; and told him (falsely) that someone was counting parts and would lose count if he spoke. Bob, Larry's team leader, had accompanied Larry to therapy sessions and monitored his use of medications. The company had put him on probation several times.

Peers also covered for mistakes due to skills that were inadequate for the job at hand. Nate's team leader, Max, described one such incident:

Once a mistake was made. Nate didn't use one of the gauges listed on the process to check his parts....I almost turned and said, "Did you see that on the process?" Then I remembered he doesn't read. Nate said, "I wasn't aware that gauge was available." There were other people around. Someone said that the guy who set up the job should have put all the parts out [so Nate would not have needed to read the list]. This made Nate look better. So the setup guy was told to include all tools in the setup for Nate. All took responsibility for the mistake.

3. SUMMARY

In summary, the skills-poor were at a disadvantage at Hardy. By definition, they had fewer skills to assist them in doing competent work, which included a great deal of literacy. They faced two sets of educational goals while their more skilled coworkers faced only one. In addition, they were not apt to be selected for work in settings that structured practice in literacy and other skills. Finally, the special teaching and learning strategies that they experienced, while sometimes promising, were not polished for their educational needs. The skills-poor may have *constructed* literacy lessons in the settings they encountered, but these settings were not *designed for* optimal skill development. Instead, they were tied to the needs of production, the exigencies of the moment, and the ingenuity and good will of coworkers for whom the teacher role was not always a priority.

CONCLUSIONS

Teamwork substantially increases the demand for literacy skills.

Effective communication is the glue that holds together team members' labor and enables them to coordinate their work with that of other teams. Moreover, since teamwork emphasizes workers' responsibility, decision making, and quality production, it extends the topics about which they need to communicate in order to fulfill their job requirements.

In response to the growing demand for new literacy competencies associated with teamwork, workers appear to develop diverse literacy skills.

Under a high performance production model, manufacturing workers engage in a much wider variety of activities that require more sophisticated literacy and numeracy skills than was usual under a Tayloristic production model. They plan and improve production processes, design equipment, troubleshoot problems that arise with products and workers, and educate themselves and others. These tasks and responsibilities require facility in diverse written and oral media and involve frequent interaction with peers, engineers, and managers as well as customers and producers outside the company. Because success on the job depends on literacy learning and because they deem educational achievement as both worthy in itself and an avenue to self-respect, workers tend to welcome and extend opportunities to improve their skills and generally succeed in raising their skill levels. As a consequence, they create a skills-rich environment from which teams can draw. For the company as a whole, teamwork may be a route to a more productive workforce.

Team organization in the workplace opens rich possibilities for literacy education.

Teams bind people together in long-term work relationships with common aims and shared structures of space, time, and tasks. In such an environment workers become both teachers and learners of literacy skills. As the demands for skills and team responsibility increase, workers both seek and offer assistance, create on-the-job training, and refine their understanding and practice of education. Some workers develop explicit teaching methods to help team members perform literacy tasks they cannot

do independently, thus building figurative scaffolds to support learners until they can perform independently.

The educational opportunities in a team environment can be both a benefit and a burden to skills-poor workers.

To fulfill their educational potential, the team learning environment needs to be carefully constructed and supported. While skills-poor workers value general education and greater workplace skills, they may feel that the skills are out of reach because of their own limited abilities or because the effort required places demands on their time, energy, and families that they cannot meet. Moreover, the skills-poor may encounter restricted educational opportunities. The data from Hardy shows how factors such as access to events where literacy is practiced, options for participation, and flexibility in teaching approaches are crucial in determining the effectiveness of education for skills-poor workers.

The company that enhances its workforce capability by restructuring work and incentives for learning takes on many functions of an educational institution.

These functions affect the definitions of work, education, and literacy, not only inside the company but also in the full context of workers' lives and in other institutions (e.g., community colleges) that are affected by the company. Just as schools are powerful in defining literacy practices and literacy competencies in settings throughout society (Cook-Gumperz, 1986), companies that design educational programs may shape the concept of literacy in many settings. Team-based workplace education can be a crucible for innovative instructional approaches both in workplaces and in other educational settings. Project-oriented and hands-on approaches in particular may be refined for workers and adapted to school settings for adults.

Yet education within the confines of a company system has inherent limits related to the aims of company life. It is not only the skills-poor who need additional and alternative sources of high quality formal and informal education. More studies are needed about whether the needs of individual workers, society, or even industry itself can best be filled by education driven by or centered in the workplace.

ENDNOTES

1 The company name and the names of all individuals, teams, and products are pseudonyms.

2 The company encouraged all workers to acquire this skill for the sake of safety. Occasionally an untrained worker would drive a forklift to expedite some business. As a result, a serious accident occurred around the time of the study.

3 While Hardy management emphasized each individual's duty to maintain high standards as well as team responsibility for work and the environment in which it is carried out, the issue of individual responsibility is not addressed in detail in this report.

4 Judy said that she also regularly works on SPC charts at home because she was too busy at work: "They only take a couple of minutes but if I'm here I'm doing something—checking out hubs, or I want to build up to a certain point to keep myself caught up. So I say I'm going to build 'til 25 [hubs] and [give myself] five minutes for clean-up. I don't give myself that much sit-down time. Or someone else comes to ask me something."

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APPENDIX

Figure 1	*Literacy Practices During Production, Meetings, and Pay-for-Knowledge Activities*	*A-iii*
Form 1	*Failure Mode and Effects Analysis (F.M.E.A.) Form*	*A-iv*
Notebook Exhibition 1	*Anne's Dryer Design*	*A-v*
Notebook Exhibition 2	*Judy's List of Machine Names and Numbers*	*A-vi*
Notebook Exhibition 3	*Minutes of Cell Meeting*	*A-vii*
Notebook Exhibition 4	*List of Processes Being Worked on by the Cell*	*A-ix*
Notebook Exhibition 5	*Old Process Control Instructions*	*A-xi*
Notebook Exhibition 6	*Engineering Bill of Materials List*	*A-xii*
Notebook Exhibition 7	*Judy's To-Do List*	*A-xiii*
Notebook Exhibition 8	*Edited 480 Process Control Instructions*	*A-xiv*
Notebook Exhibition 9	*Edited Materials Pick List*	*A-xvi*
Notebook Exhibition 10	*Dale's Diagram of Analyses of Team's Housekeeping Problem*	*A-xvii*

Note: Although the quality of reproduction is poor, these drawings and charts have been included to give the reader the opportunity to view the work papers and forms of the people involved in the study.

Figure 1. Literacy Practices During Production, Meetings, and Pay-For-Knowledge Activities

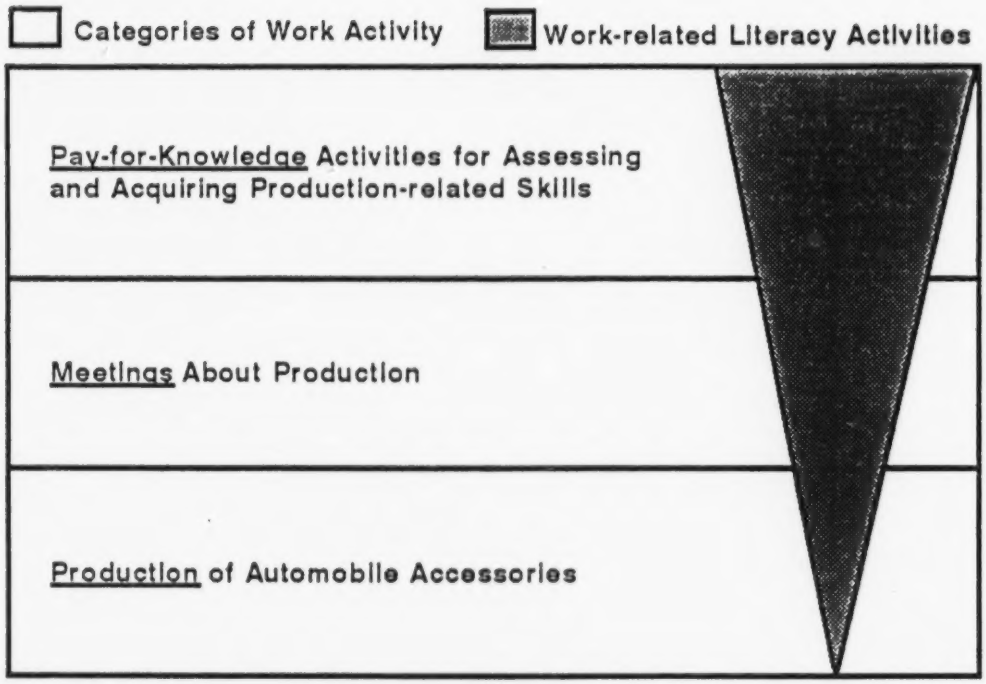

Categories of Work Activity
Work-related Literacy Activities
Pay-for-Knowledge Activities for Assessing and Acquiring Production-related Skills
Meetings About Production
Production of Automobile Accessories

Figure 1. Literacy Practices During Production, Meetings, and Pay-for-Knowledge Activities

(name) INDUSTRIES

POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (PROCESS FMEA)

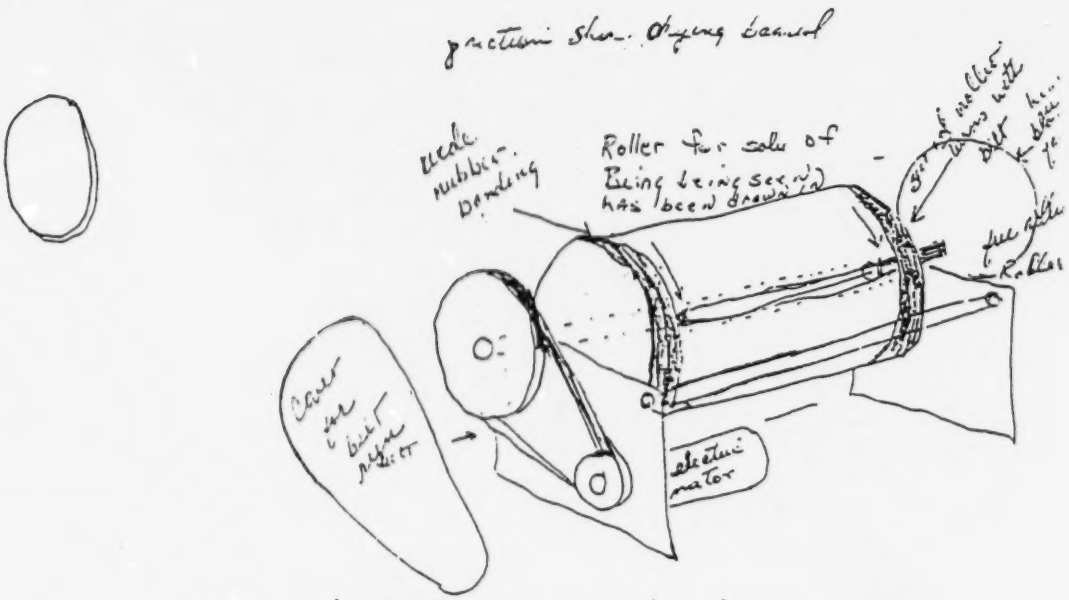
PART OR PROCESS NAME/NO.: CUSTOMER: PREPARED BY: (name)

SUPPLIERS: TEAM: DATE: REV:

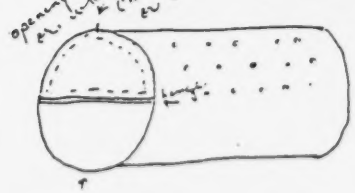
PROCESS DESCRIPTION AND PURPOSE	POTENTIAL FAILURE MODE	POTENTIAL EFFECTS OF FAILURE	SEV	POTENTIAL CAUSE(S) OF FAILURE	OCC	CURRENT CONTROLS	DET	RPN	RECOMMENDED ACTION(S)	RESPONSIBLE PERSON AND DATE	ACTIONS TAKEN	SEV	OCC	DET	RPN

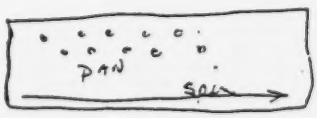
Page 1

Form 1. Failure Mode and Effects Analysis (F.M.E.A.) Form



electric motor which drives a pulley connected via a belt





also considered
dryer element +
blower fan mounted
frame

other idea - spinning spun to cause centre force pushing water to out side of pan - three holes speed would

BEST COPY AVAILABLE

Press - 6151
screw gun 6#
date stamp 6148
IDG press 170700
greaser

(name) Industries. . .Meeting Minutes

TITLE: (part no.) Cell Quality Improvement Process (Assembly) DATE HELD:

LOCATION: (name) Training Room TIME:

FACILITATOR: (name) REF. NO:

(Mark "P", "A", or "C" for those Present, Absent, or Copied)

1.	(list of names)	P	11.	
2.		P	12.	
3.		A	13.	
4.		P	14.	
5.		A	15.	
6.			16.	
7.			17.	
8.			18.	
9.			19.	
10.			20.	

Key items discussed and action taken/to be taken

1. Process Flow Charts:

   A. (name) to provide (name) with new flow based on line redesign by (date).

   B. (name) to provide flow charts (4) by (date).

2. FMEA: FMEA for (part) has been started; anticipate completion by (date).

3. Update Spec & Drawings: (Name) has been unavailable to work n this project (Name) will follow up with (Name).

4. (name) to check with (name) on next build date for (name) to arrange for photographs.

5. Project completion dates revised for (part no.).

6. (name) to assist (name) in locating existing process for (part no.) (part no.).

Page 2 . . .
(part) Cell (Assy) Quality Improvement
Meeting Minutes (date)

7. Next meeting to be held (date) at 10:00 a.m. in the (name) Training room.

AGENDA:

- Review progress & action items.
- Update specs and drawings for (part no.)
- Develop process for (part no.).

Notebook Exhibition 4. List of Processes Being Worked on by Cell

Page 3 . . .
(part) Cell (Assy) Quality Improvement
Meeting Minutes (date)

(part no.)		
ACTIVITY	RESPONSIBLE	DUE DATE
Process Flow Chart	(list of names)	(dates)
Verify Bill of Material		
Update Specifications & Drawings		
Create Process		
Process FMEA's		
Finalize Process Control Instructions		
Worksite Standards		

(part no.)		
ACTIVITY	RESPONSIBLE	DUE DATE
Process Flow Chart	(list of names)	(dates)
Verify Bill of Material		
Update Specifications & Drawings		
Create Process		
Process FMEA's		
Finalize Process Control Instructions		
Worksite Standards		

(part no.)		
ACTIVITY	RESPONSIBLE	DUE DATE
Process Flow Chart	(list of names)	(dates)
Verify Bill of Material		
Update Specifications & Drawings		
Create Process		
Process FMEA's		
Finalize Process Control Instructions		
Worksite Standards		

Notebook Exhibition 4. List of Processes Being Worked on by Cell (Continued)

Page 4 . . .
(part) Cell (Assy) Quality Improvement
Meeting Minutes (date)

(part no.) (EACH)		
ACTIVITY	RESPONSIBLE	DUE DATE
Process Flow Chart		(date)
Verify Bill of Material		
Update Specifications & Drawings		
Create Process		
Process FMEA's		
Finalize Process Control Instructions		
Worksite Standards		(date)

(part no.) (BULK)		
ACTIVITY	RESPONSIBLE	DUE DATE
Process Flow Chart		(date)
Verify Bill of Material		
Update Specifications & Drawings		
Create Process		
Process FMEA's		
Finalize Process Control Instructions		
Worksite Standards		(date)

Notebook Exhibition 5. Old Process Control Instructions

PROCESS CONTROL INSTRUCTIONS

DOCUMENT NUMBER: REV:

(name) INDUSTRIES, AUTOMOTIVE-PORTLAND, OR

DATE:

STATION #1

(part) ASSEMBLY

1. APPLY DECAL, USING PRESSURE, TO CONTROL DIAL MATCHING ARROW ON DECAL WITH ARROW ON DIAL. LOOK FOR COSMETIC DEFECTS.

   NOTE: PRESSURE SHALL BE APPLIED TO THE ENTIRE SURFACE OF THE DECAL WHEN APPLYING.

2. ASSEMBLE COMPONENT PARTS ON ASSEMBLY FIXTURE

   A. VISUALLY INSPECT HUB BODY CASTING FOR COSMETIC DEFECTS

   B. PLACE DIAL SCREW ON FIXTURE

   C. PLACE O-RING ON DIAL SCREW

   D. PLACE CLUTCH NUT ON DIAL SCREW, FLAT SIDE DOWN

   E. PLACE LARGE COIL OF SPRING ON CLUTCH NUT

   F. PLACE BODY TO FIXTURE (TIMED TO POST)

   G. PRESS ASSEMBLY DOWN BY HAND AND HOLD

      NOTE: VERIFY O-RING IS SEATED

   H. PLACE DIAL IN BODY AND PUSH IN PLACE (ARROW TO "LOCK")

   I. PLACE AND RUN DOWN SCREW

   J. CHECK FOR LOOSE SCREW BY PRESSING ENDS OF DIAL DOWN WITH THUMBS BEFORE REMOVING FROM SPUD

   K. APPLY DECAL, USING PRESSURE, TO CONTROL DIAL MATCHING ARROW ON DECAL TO ARROW ON DIAL. LOOK FOR COSMETIC DEFECTS ON DECAL.

ENGR REP (initials) FLOOR REP (signature) REV: PAGE 1 OF 7

NOW, (date)

SINGLE LEVEL ENGINEERING BILL OF MATERIAL AS OF (date) FOR SELECTED PARTS PAGE 1

1990
Revision Level: E0 Engineering Status: Comment:

Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	S C	D i s	P ht so m
101					C0	Wear Washer, Hub	1	EA	P		
102					CH	SEAL,O-RING	1	EA	P		
103					CH	RING,RETAINING	1	EA	P		
104					B0	SCREW,DIAL	1	EA	P		
105					B0	NUT,CLUTCH	1	EA	P		
106					K0	RING.CLUTCH	1	EA	M		
107					B0	SPRING,COMP,HEAVY	1	EA	P		
108					B0	SPRING,HELICAL COMP	1	EA	P		
109					CH	RING,RETAINING	1	EA	P		
110					C0	SLEEVE,BEARING	1	EA	P		
111					CH	BEARING,NEEDLE ROLLER	1	EA	P		
112					E0	CONTROL DIAL,RAISED BLACK	1	EA	P		
113					CH	SEAL,O-RING	1	EA	P		
114					CH	SCR,TPHG,8-18X5/8,FL HD,X	1	EA	P		
115					J0	BODY,HUBLOCK	1	EA	M		
116					K0	GEAR.INNER DRIVE	1	EA	M		
117					F0	DECAL,CONTROL DIAL	1	EA	P		
118					A0	LUBRICANT,GREASE,MOLY 1	A/R	LB	P		
201					A0	TUBE, CARDBOARD	1	EA	P		
202					A0	PALLET,BULK SHIPMENT	.0022	EA	P		
203					A0	TUBE,GLUED	A/R	EA	P		
204					A0	BOX,TOP,SCD	A/R	EA	P		
205					A0	PAD,LAYER,37X37,200 LB,SV	A/R	EA	P		
9000					A0	PROCESS INSTR., M250A	A/R	EA	D		
9001					B0	ASSY DWG., M250A BULK	A/R	EA	D		

Notebook Exhibition 7. Judy's To-Do List

1. Waiting for photos (PART NO.)
2. (NAME) will asked (NAME) about updated Specifications & drawings
3. FMEA's started for (PART NO.)
4. FMEA's not started
5. Change date on worksite standards
6. Fixture numbers for (PART NO.)
7. (PART NO.) Build (DATE)

PROCESS CONTROL INSTRUCTIONS
DOCUMENT NUMBER: REV:
PART NO: REV:
PART DESC: MANUAL HUBLOCK
DATE:

OPERATION #1
PRE-ASSEMBLY SET UP

Same 1. Ensure that all components from previous work orders have been returned to stocking location prior to beginning this process.

Same 2. Observe Traveler for Work order and determine quantity of product to be built.

Same 3. You will need to have the following equipment/fixture(s) in place to complete this assembly; see *Figure 1*:

different pictures

Figure 1

same NOTE: Be sure that the equipment/fixture is in proper working order and that you are familiar with the safe operation of same (refer to your cell Worksite Standards).

part Using the Material Pick List contained in the job packet, pull the components necessary to complete this assembly.

ENG REP ____ FLOOR REP____ QLTY REP ____ PAGE 1 OF 29

PROCESS CONTROL INSTRUCTIONS
DOCUMENT NUMBER: REV:
PART NO: REV:
PART DESC: MANUAL HUBLOCK
DATE:

OPERATION #3 (Cont)
HUB BODY ASSEMBLY

8. ~~Assemble Dial Screw Nut to single coil end of Spring~~

NOTE: ~~Spring must not overlap, see Figure 9~~

8. Place clutch nut on dial screw, flat side down

9. Place large coil of spring on clutch nut

Figure 9

(2) page 3
(AS MARKED BELOW)

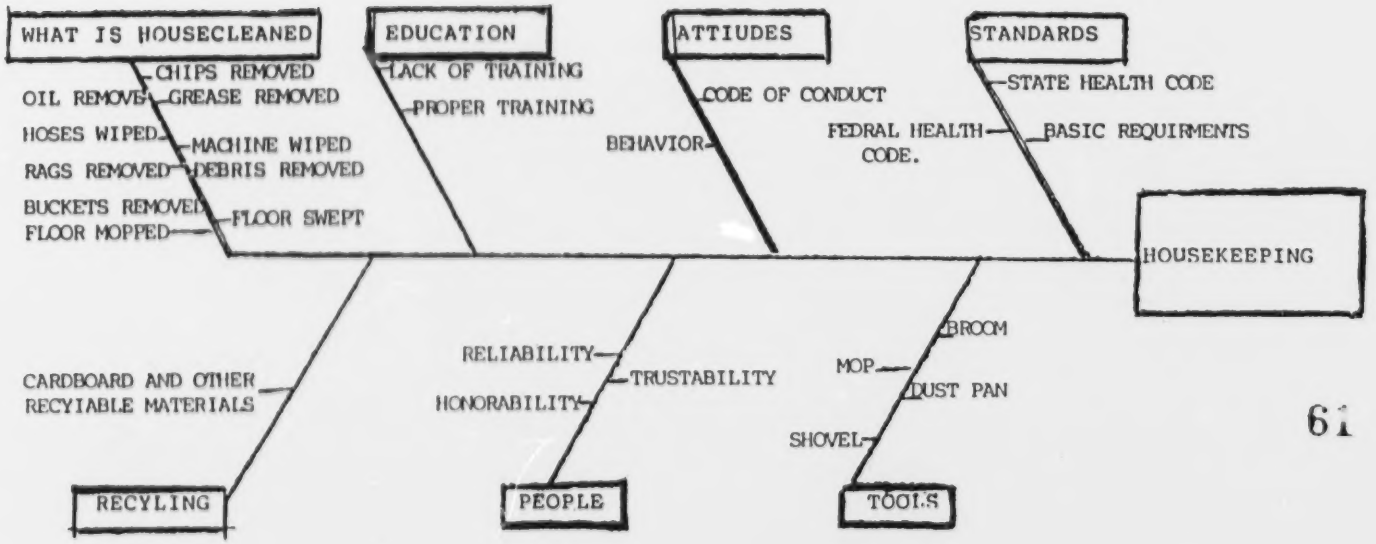
(name) INDUSTRIES
SINGLE LEVEL ENGINEERING BILL OF MATERIAL 19 CF FOR SELECTED PARTS ADN. (date) PAGE 1

M998
Revision Level: 10 Engineering Status: Comments

Line	Rev.	Start Date	Stop Date	Part Number	Rev.	Description	Quantity	U/M	Sc	Ins	Phtn
101					CO	Wear Washer, Hub	1	EA	P		
102					CH	SEAL,O-RING	1	EA	P		
103					CH	RING,RETAINING	1	EA	P		
104					BO	SCREW,DIAL	1	EA	P		
105					BO	NUT,CLUTCH	1	EA	P		
106					KO	RING,CLUTCH	1	EA	M		
107					BO	SPRING,COMP,HEAVY	1	EA	P		
108					BO	SPRING,HELICAL COMP	1	EA	P		
109					CH	RING,RETAINING	1	EA	P		
110					CO	SLEEVE,BEARING	1	EA	P		
111					CH	BEARING,NEEDLE ROLLER	1	EA	P		
112					EO	CONTROL DIAL,RAISED BLACK	1	EA	P		
113					CH	SEAL,O-RING	1	EA	P		
114					CH	SCR,TPHG,8-10X5/8,FL HD,X	1	EA	P		
115					JO	BODY,HUBLOCK	1	EA	M		
116					KO	GEAR,INNER DRIVE	1	EA	M		
117					FO	DECAL,CONTROL DIAL	1	EA	P		
118					AO	LUBRICANT,GREASE,MOLY 1	A/R	LB	P		
201					AO	TUBE, CARDBOARD	1	EA	P		
202					AO	PALLET,BULK SHIPMENT	.0027	EA	P		
203					AO	TUBE,GLUED	A/R	EA	P		
204					AO	BOX,TOP,SCD	A/R	EA	P		
205					AO	PAD,LAYER,32X32,200 LB,SV	A/R	EA	P		
000					AO	PROCESS INSTR., M250A	A/R	EA	D		
001					BO	ASSY DWG., M250A BULK	A/R	EA	D		

PROBLEM SOLVING ON HOUSEKEEPING:

NON- STANDARDIZED HOUSEKEEPING BETWEEN TEAMS IS REDUCING THE QUAILITY OF OUTPUT AS WELL AS BEING A DETRIMENT TO PROFESSIONALISM AND MORALE.



Notebook Exhibition 10. Dale's Diagram of Analyses of Team's Housekeeping Problem